



Final Report for Pollution Prevention Grant Program

Indiana Department of Environmental Management

Office of Pollution Prevention and Technical Assistance

POLLUTION PREVENTION GRANT PROGRAM

100 N. Senate Avenue, Mail Code 64-00

Indianapolis, IN 46204-2251

Internet: www.in.gov/idem/prevention/p2grants/

INSTRUCTIONS: The Report Form is designed to satisfy standard grant reporting requirements. Grantee should consult Exhibit A of their grant agreement for additional reporting requirements. Attach additional sheets if necessary and label attachments according to the number of the final report question.

SECTION 1 GRANT INFORMATION

Date:	9-5-08	EDS #:	A305-8-133
Grantee:	Nimet Industries, Inc.		
Person Completing Report:	Brian Myers		

SECTION 2 REPORT QUESTIONS

1) Please provide a summary of grant funded activities.
Source Reduction – Nimet Industries, Inc. installed an Electroless Nickel Dialysis Unit to indefinitely extend the life of electroless nickel plating solutions. By extending the electroless nickel solution life, this dialysis unit has significantly reduced waste generation.

A Electroless Nickel Dialysis Unit is a re-purification system that extracts the unwanted by-product from the electroless nickel plating solutions. Electroless Nickel Dialysis is an electrically driven ion-exchange utilizing alternating sequences of cation membranes and anion membranes. When the membranes are electrically charged, they selectively identify and extract unwanted dissolved solids from the spent electroless nickel plating solutions. This permits the unaffected nickel to remain in the cleaned bath to be repeatedly recycled back into production service.

This technology has been evaluated and tested by Lawrence Livermore National Laboratory and the United States EPA Region 9. The Lawrence Livermore National Laboratory test was conducted in 1995. Their conclusion was that the cost of the equipment is quickly recovered by the reduced purchase of chemicals. They also stated that the Electroless Nickel Dialysis Unit offers the user significant economic as well as environmental benefits. The US EPA Region 9 Pollution Project (P2) conducted in 1998 came to similar conclusions.

Nimet Industries, Inc. learned of this technology at a trade show for metal finishers. We contacted the manufacturer and received an information packet about the Electroless Nickel Dialysis Unit. The information was evaluated and independently verified. We arranged a site visit at the manufacturer with Nimet and Nimet's electroless nickel chemical supplier. The electroless nickel chemical supplier was impressed with the Electroless Nickel Dialysis Unit and was confident that their chemistry would work with it. Nimet then ordered a Electroless Nickel Dialysis Unit. A Nimet employee was at the manufacturer during construction of the unit and assisted in the assembly. During the assembly of the unit, training on troubleshooting and maintenance was performed.

The initial testing of the Electroless Nickel Dialysis Unit in Massachusetts and at our facility proved this technology works. The unit was tested after assembly to ensure that there were no leaks, that the membrane build up was done correctly, and that the rectifier provided the correct voltage and current. After the unit arrived at our facility it was again tested to ensure that there was no damage during shipping and that the unit would work with electroless nickel chemistry. There are many electroless nickel chemistry manufacturers and each one has their own blend.

During the second operation of the Electroless Nickel Dialysis Unit at our facility the rectifier failed. A rectifier converts AC current into DC current. The unit was shutdown and the rectifier was removed and returned to Zero Discharge for a replacement rectifier. After the replacement rectifier was installed it was discovered that when the original rectifier failed it caused damage in the membrane stack. The membrane stack was removed and sent back to Zero Discharge for repair. Zero Discharge repaired the membrane stack and shipped it back to Nimet. During the return shipping process the membrane stack received significant damage due to negligence of the shipping company. Again the membrane stack was returned to Zero Discharge for repair. The membrane stack has been repaired and is awaiting return shipment on a secure carrier.

While the startup process has not gone smoothly, I still feel confident that this technology is sound and will work.

The projected savings of chemicals and reduction of waste generation are based on the successful initial run of the Electroless Nickel Dialysis Unit. Zero Discharge has confirmed that these numbers are consistent with other installed units.

a) Were the goals outlined in the grant application attained?
Yes – See Attachment A

2) Has the amount of pollutants decreased and/or has the amount of conserved natural resources increased?
Yes – See Attachment A

a) Provide increase or decrease in appropriate metrics and provide the method for calculating this.
Based on the initial test run of the Electroless Nickel Dialysis Unit there was a 75% decrease in amount of non-hazardous waste generation. Before installation of Electroless Nickel Dialysis Unit a spent 150 gallon bath would be shipped out as non-hazardous waste. With the Electroless Nickel Dialysis Unit in operation only 37 gallons of non-hazardous waste is generated and 113 gallons can be reused.

3) Provide an annual projection of the amount of pollutants decreased or natural resources conserved.
Reduced Generation of Waste – 9750 gal/year (13,000 gallon shipped out as waste in 2007)
Reduced Chemical Use – 2291 gal/year (3055 gallons of electroless nickel chemistry used in 2007)
Reduced Water Use – 7268 gal/year (9690 gallons of water used to make electroless nickel baths in 2007)

a) Provide the method for calculating this number(s)?

The reduction of Waste Generation, Chemical Use, and Water Use numbers were based on previous years waster generation, chemical usage, and water usage.

4) If someone wanted to emulate your project, what information would be most helpful? Please outline successes and failures so others can learn from your project.

The best advice would be to help assemble Electroless Nickel Dialysis Unit. You will learn more in that one day on the construction, operation, and maintenance then you could ever get from reading the manuals. Work as a team with the facilities personnel and end users. Some of their ideas will be better than yours.

See Attachment A

5) Provide a program sustainability plan that indicates how you will continue the program without grant funding.

Normal housekeeping and common sense are required to keep the Electroless Nickel Dialysis Unit functioning at its peek efficiency. Keep the unit clean, wipe up any spilled liquids, and change filters regularly. Only consumables for normal operation are filter canisters. Membranes should have an approximately lifespan of 10 years.

6) Attach a completed Grant Expenditure Report that details all expenditures made during the grant term.

See Attached Grant Expenditure Report

Attachment A

The initial testing of the Electroless Nickel Dialysis Unit in Massachusetts and at our facility proved this technology works. The unit was tested after assembly to ensure that there were no leaks, that the membrane build up was done correctly, and that the rectifier provided the correct voltage and current. After the unit arrived at our facility it was again tested to ensure that there was no damage during shipping and that the unit would work with electroless nickel chemistry. There are many electroless nickel chemistry manufacturers and each one has their own blend. Based on the chemistry that Nimet was using, Zero Discharge predicted that the Electroless Nickel Dialysis Unit would need to run approximately 48 hours to dialyze a 150 gallon bath. Over a two day period the Electroless Nickel Dialysis Unit was operated for 28 hours. A solution sample was then tested to determine how far along the dialysis process was. To our and Zero Discharge's surprise, the dialysis process had removed all of the impurities and started removing nickel from the bath. A second test was planned. Earlier and more frequent testing was planned.

During the second operation of the Electroless Nickel Dialysis Unit at our facility the rectifier failed. A rectifier converts AC current into DC current. The unit was shutdown and the rectifier was removed and returned to Zero Discharge for a replacement rectifier. After the replacement rectifier was installed it was discovered that when the original rectifier failed it caused damage in the membrane stack. The membrane stack was removed and sent back to Zero Discharge for repair. Zero Discharge repaired the membrane stack and shipped it back to Nimet. During the return shipping process the membrane stack received significant damage due to negligence of the shipping company. Again the membrane stack was returned to Zero Discharge for repair. The membrane stack has been repaired and is awaiting return shipment on a secure carrier.

The projected savings of chemicals and reduction of waste generation are based on the successful initial run of the Electroless Nickel Dialysis Unit. Zero Discharge has confirmed that these numbers are consistent with other installed units.

E/N Dialysis Unit Operation

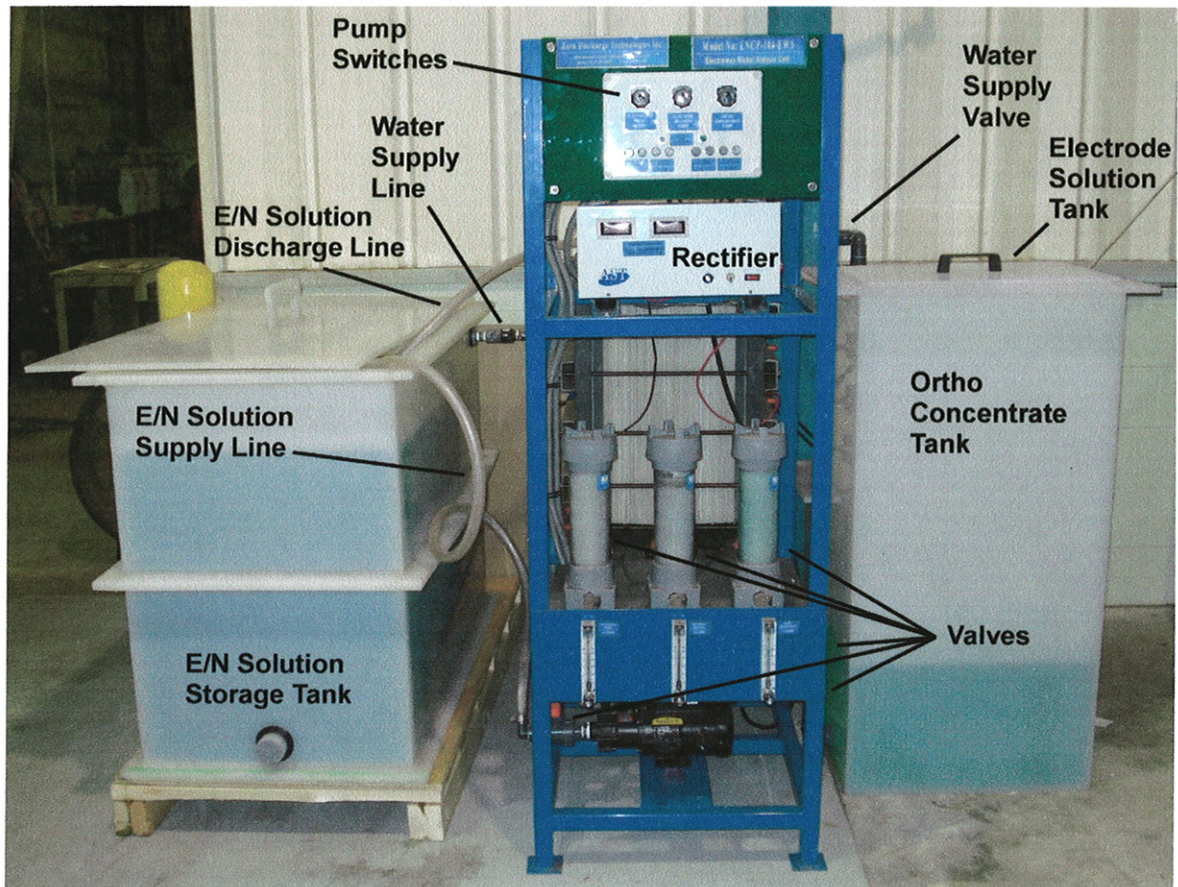


Figure 1. E/N Dialysis Unit

CAUTION

E/N Solution Storage Tank needs to be filled with 150 gallons of E/N solution for proper operation of E/N Dialysis Unit.

E/N solution must be below 120°F to prevent damage to membranes on E/N Dialysis Unit.

1. Ensure E/N Solution Discharge Line is in E/N Solution Storage Tank (figure 1).
2. Ensure E/N Solution Supply Line is in E/N Solution Storage Tank.
3. Ensure Water Supply Line to E/N Solution Storage Tank is connected.



Figure 2. Water Valve

4. Slightly open Water Supply Valve (figure 2).

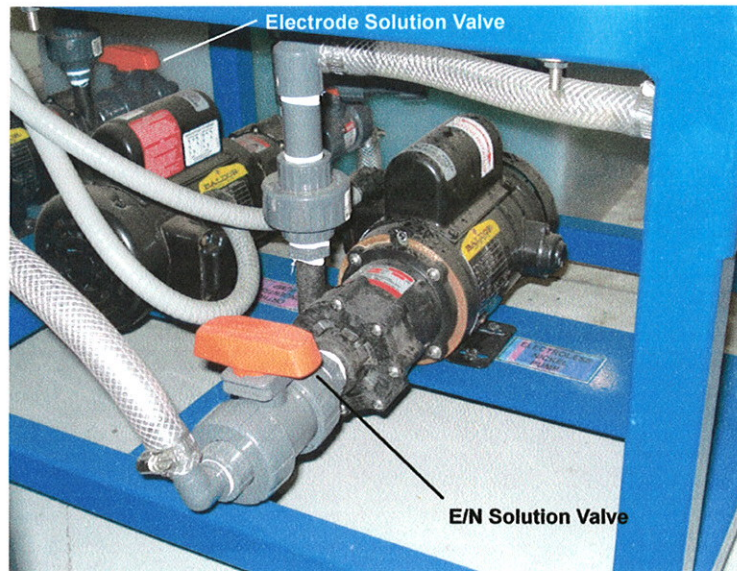


Figure 3. Electrode and E/N Solution Valves



Figure 4. Ortho Concentrate Valve

5. Open 3 valves (Electrode, E/N Solution, and Ortho Concentrate) to inlets of pumps (figures 3 and 4).

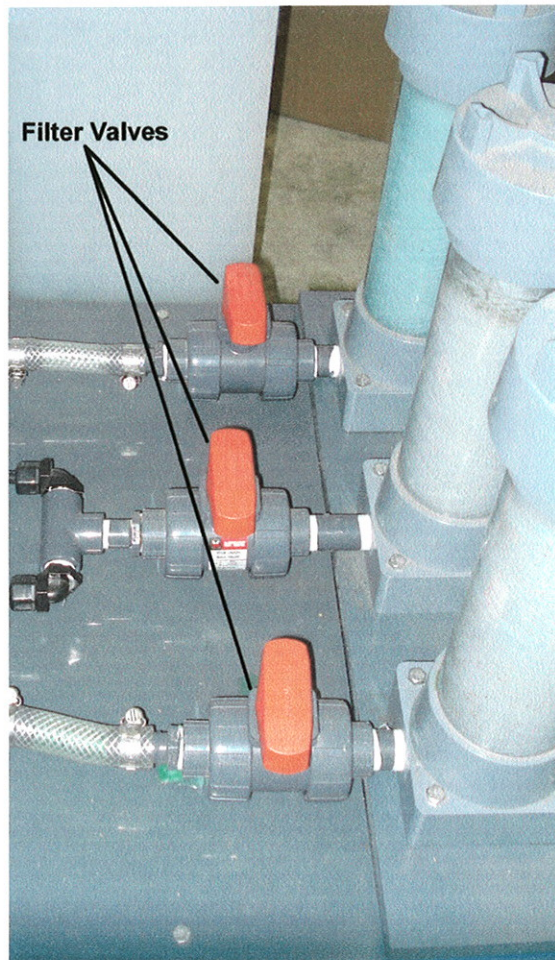


Figure 5. Filter Valves

6. Open 3 valves behind filters (figure 5).

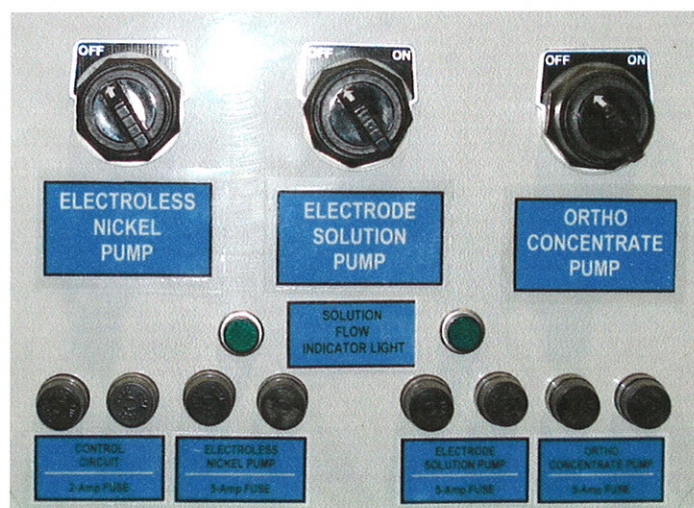


Figure 6. Pump Switches

7. Turn on the 3 switches for the pumps (figure 6).
8. Collect E/N solution sample from E/N Solution Storage Tank.
9. Determine initial concentration as follows:
 - a. Pipette 2 ml sample into a beaker and dilute to 100 ml with RO water.
 - b. Record TDS using TDS Meter.
 - c. Multiply reading by 50,000 to determine TDS in ppm for initial concentration of E/N solution.
 - d. Record Date, Time and TDS on Log Sheet.

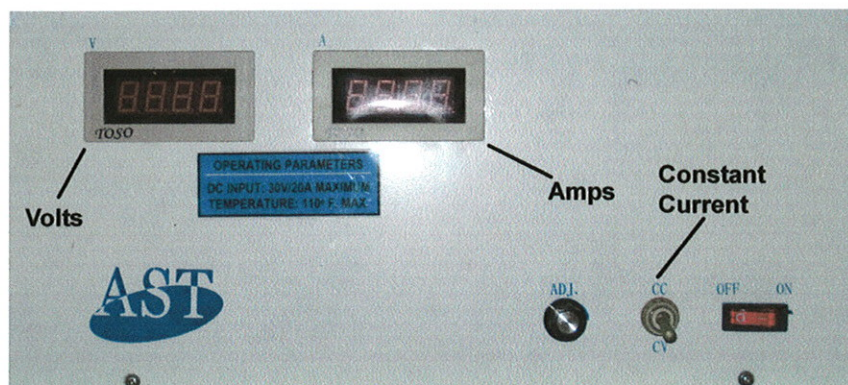


Figure 7. Rectifier

NOTE

Rectifier will not operate unless Solution Flow Indicator Lights are illuminated on Pump Switch Panel.

10. Turn on Rectifier. Ensure that Rectifier is set-up for Constant Current (CC) and that the current is set for 20 Amps (figure 7).
11. When dialysis process is complete:
 - a. Turn off Rectifier (figure 7).
 - b. Turn off the 3 switches for the pumps (figure 6).
 - c. Close 3 valves behind filters (figure 5).
 - d. Close 3 valves (Electrode, E/N Solution, and Ortho Concentrate) to inlets of pumps (figures 3 and 4).
 - e. Close Water Supply Valve (figure 2).
 - f. Determine concentration as follows:
 - i. Pipette 2 ml sample into a beaker and dilute to 100 ml with RO water.
 - ii. Record TDS using TDS Meter.
 - iii. Multiply reading by 50,000 to determine TDS in ppm for initial concentration of E/N solution.
 - iv. Record Date, Time and TDS on Log Sheet.
12. Before moving E/N Solution Storage Tank:
 - a. Disconnect Water Supply Line to E/N Solution Storage Tank (figure 1).
 - b. Remove E/N Solution Supply Line from E/N Solution Storage Tank.
 - c. Remove E/N Solution Discharge Line from E/N Solution Storage Tank.

Ortho Concentrate Tank

The solution in the Ortho Concentrate Tank will need to be lowered periodically.

CAUTION

Ensure E/N Dialysis Unit must not be in use before lowering Ortho Concentrate Tank.



Figure 8. Ortho Discharge and Concentrate Valves

1. Connect Ortho Discharge Line to Ortho Discharge Valve (figure 8).
2. Ensure Ortho Discharge Line is in E/N Solution Recycling Tote.
3. Open Ortho Discharge Valve.
4. Open Ortho Concentrate Valve.
5. Turn on Ortho Concentrate Pump.
6. Lower Ortho Concentrate until approximately 20 gallons remains in Ortho Concentrate Tank.
7. Turn off Ortho Concentrate Pump.
8. Close Ortho Concentrate Valve.
9. Close Ortho Discharge Valve.
10. Remove Ortho Discharge Line from E/N Solution Recycling Tote.
11. Disconnect Ortho Discharge Line.
12. Store Ortho Discharge Line in safe location.

Electrode Solution Tank

The solution in the Electrode Solution Tank will need to be changed when solution has a light green color.

CAUTION

Ensure E/N Dialysis Unit must not be in use before changing solution in Electrode Solution Tank.

Ensure that all of the sodium sulfate crystals have dissolved before starting E/N Dialysis System.

NOTE

Sodium sulfate crystals will dissolve better in warm water.

1. Empty solution from Electrode Solution Tank.
2. Dissolve 5678 g (12.51 lbs) in 15 gallons of water.

E/N Dialysis TDS Log

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